CLAIMS

1. A variable damper comprising;
an outer member including a magnetically conductive sleeve;
an inner member comprising a shaft;
an electromagnet supported between the members;
wherein
a chamber between the outer and inner members is at least partially filled with magnetorheological fluid (MRF), such that when a magnetic field is applied to the chamber, the effective viscosity of the fluid increases such that relative motion of the inner and outer members is opposed;
the region between the electromagnet and the sleeve defining a control region in which the magnetic field is concentrated.

2. A variable damper as claimed in Claim 1 wherein, the electromagnet is supported on the outer member.

3. A variable damper as claimed in Claim 2 wherein, the electromagnet is supported by a plurality of struts arranged perpendicular to the shaft.

4. A variable damper as claimed in Claim 1 wherein, the electromagnet is supported on the inner member.

5. A variable damper as claimed in Claim 4 wherein, the inner member comprises interconnected first and second shaft portions between which is arranged a housing comprising the electromagnet.

6. A variable damper as claimed in any preceding Claim wherein, a diaphragm seal portion is provided at each end of the shaft to bound the chamber.

7. A variable damper as claimed in Claim 6 wherein, the seal portion has an elasticity to allow the inner member to rotate in planes perpendicular to the seal portion.

8. A variable damper as claimed in Claim 6 wherein, the seal portion has an elasticity to reduce at least one degree of freedom of the relative motion of the inner and outer members.

9. A variable damper as claimed in any preceding Claim wherein the outer member includes a secondary housing at least at one body end surface, the/each secondary housing comprising a hollow cylindrical body including an aperture through which the shaft extends.

10. A method of variably damping relative motion between an outer member including a magnetically conductive sleeve and an inner member, comprising the steps:

(a) supporting an electromagnet between the members such that a flow path exists between the electromagnet and the sleeve;
(b) placing a magnetorheological fluid between the members;
(c) applying a minimal magnetic field to the electromagnet;
(d) increasing the field in the flow path; and

(e) increasing viscosity of the fluid to thereby oppose relative motion of the membranes and create damping with minimal off-state.

10. A vibration control system for reducing vibrations between a first and a second element, a magnetorheological fluid variable damper being located between the elements and operated to cause active damping between the elements, wherein the system has a relative figure of merit of less than 0.83.

11. A vibration control system as claimed in Claim 11 wherein the relative figure of merit is less than or equal to 0.5.

12. A vibration control system as claimed in Claim 10 or Claim 11 wherein the magnetorheological fluid variable damper is according to anyone of Claims 1 to 9.

13. A vibration control system as claimed in any one of Claims 10 to 12 wherein the shaft is connected to the first element and the housing is connected to the second element; and the system further comprises a spring located between elements; first and second accelerometers located between the damper and the respective first and second elements; and a control unit for inputting accelerometer values and outputting a small electric current to the electromagnet, to cause active damping between the first and second elements.

14. A vibration control system as claimed in Claim 12 or Claim 13 wherein the inner and outer members of the damper are configured to be suitable for attachment to components of a device, such that the application of relative forces between the components results in corresponding forces being applied to the inner and outer members of the damper.

15. A vibration control system as claimed in Claim 14 wherein, a parasitic power generator is incorporated within or on the device to provide the electric current that drives the electromagnet.

16. A vibration control system as claimed in Claim 14 or Claim 15 wherein, the device comprises at least one sensor that detects a variable, the value of which can be used to determine a desire amount of electric current to be applied to the electromagnetic coil.

17. A vibration control system as claimed in Claim 16 wherein an intelligent control unit (ICU) is provided, which is capable of receiving input signals from the sensors and outputting command signals to the damper, the command signals being derived from an algorithm used to determine a desired relationship between the input signals and the damping required.

18. A vibration control system as claimed in any one of Claims 14 to 17 wherein the device is a snowboard, one of the outer member and inner member of the damper is attached to the surface board, and the other of the inner member an outer member is attached to a raised portion formed on the board.

19. A vibration control system as claimed in Claim 18 wherein a plurality of dampers are attached to the board.

20. A vibration control system as claimed in Claim 18 or Claim 19 wherein, torsion forks are provided on the board and connected to the inner member of the device to enable control of torsional stiffness of the board.

21. A vibration control system as claimed in any one of Claims 14 to 17 wherein the device of a golf club, one of the outer member and inner member of the damper is attached to the shaft of the club, and the other of the inner member and outer member is attached to or forms the grip of the club.

22. A vibration control system as claimed in any one of Claims 14 to 17 wherein the device is a handle which is a component of a machine, wherein the machine is selected from a group comprising: a tennis racket, polo mallet, sports implement, a household tool, a power drill, a bicycle, a motorcycle, or the like.

23. A vibration control system as claimed in any one of Claims 14 to 17 wherein, the device is an engine mount, pump mount, or the like.